Hands On Activities For Teachers

Grades K - 12

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BIRDSEED MINING ACTIVITY

PURPOSE: Mining is a complex process in which relatively small amounts of valuable or useful minerals or metals (ores) are extracted from very large masses of rock. This activity will illustrate how this "needle in a haystack" process works.

OBJECTIVE: Students will be able to experience "hands-on" the difficulty that miners face in locating valuable mineral deposits. They will also learn a simple lesson in economics--a less valuable commodity may be more profitable because it is more abundant. Students will be shown the importance of clean, environmentally conscious mining, and will learn that all mining operations must be performed and pay for reclamation work.

ITEMS NEEDED:

- ✶ Wild Bird Food - any commercial birdseed mix with sunflower seeds and at least 2 other seed varieties.
- ✶ Shallow pans (inexpensive plastic paint pans work well).
- ✶ Small beads (approximately 2mm) blue, gold and silver.
- ✶ Medium beads (approximately 4-6mm) white color.

INSTRUCTIONS:

1. Divide students into groups of 4 to 6.

2. Pour approximately 1 pound of birdseed in each pan.

3. Add 2 gold beads, 4 silver beads and 8 blue beads, and 3 white beads to each pan - mix into birdseed.

4. The beads and seeds represent the following:

Gold beads	=	Gold
Silver beads	=	Silver
Blue beads	=	Copper
Sunflower seeds	=	Iron
All other seeds	=	Waste
White beads	=	Reclamation (These beads will be assigned a COST rather than a VALUE because reclamation must be done at all mining operations regardless of how much profit was made. See #7.)

5. Students search through the seed mixture and separate out or “mine” beads, sunflower seeds and other grain products, making piles of each. Allow 5 to 10 minutes for the mining activity. (NOTE: The instructor should hint to the students that they should mine NEATLY, not mixing waste seeds with their beads, sunflower seeds and not scattering seeds all over the area. Instructor can have the option of examining the work of each group, or assigning a helper to monitor each group to see how cleanly the “mining” is being done. Instructor or helper may assign an arbitrary “fine” to cover costs for “environmental damage” at the messy tables.

6. Assign a value for each type of bead or seed.
   Example follows:

Gold bead	=	Gold	=	$5.00 each
Silver bead	=	Silver	=	$4.00 each
Blue bead	=	Copper	=	$3.00 each
Sunflower seeds	=	Iron	=	$2.00 each
All other seeds	=	Waste	=	$0.00
White beads	=	Reclamation	=	$100.00 each

7. Have the students count up the number of good, silver, and blue beads, sunflower seeds from their piles and multiply the number of each by heir values given in #6. Document all information on the “Birdseed Mining Spreadsheet”. Students should also note the amount of any environmental damage fines on the spreadsheet. Students should count the number of white beads in their pile and multiply by the reclamation factor. This number should be recorded on the reclamation cost line on the spreadsheet.

8. Have each group total up the dollar value of their “mining” operation, subtracting the environmental damage fines and reclamation costs. Have each group share their success with the others. Prizes may be awarded to the best table of “miners”.

Birdseed Spreadsheet - K-3

Gold bead = GOLD:

Number of beads ________ x ________ = ________
price value

Silver bead = SILVER:

Number of beads ________ x ________ = ________
price value

Blue beads = COPPER:

Number of beads ________ x ________ = ________
price value

Sunflower seeds = IRON:

Number of Sunflower seeds ________ x ________ = ________
price value

TOTAL Value of all Products = ________________________

SUBTRACT cost of Environmental Damage fines = ________________________

SUBTOTAL = ________________________

Number of WHITE beads ________ x $100.00 = ________________________

SUBTRACT reclamation cost from SUBTOTAL = ________________________

GRAND TOTAL = ________________________

Birdseed Spreadsheet - Grades 4-12

GOLD BEAD: Each gold bead = 10 oz. of gold (or 100 oz of gold).

Number of beads ________ x 10 oz. = ________ x ________ = ________
price value

SILVER BEAD: Each silver bead = 10 oz. of silver (or 100 oz. of silver).

Number of beads ________ x 10 oz. = ________ x ________ = ________
price value

BLUE BEAD: Each blue bead = 100 lbs. of cooper (or 2,000 lbs of copper - 1 ton).

Number of beads ________ x 100 lbs. = ________ x ________ = ________
price value

SUNFLOWER SEEDS: Each Sunflower seed = 100 lbs. of iron (or 2,000 lbs of iron - 1 ton).

Number of Sunflower seeds ________ x 100 lbs. = ________ x ________ = ________
price value

TOTAL Product Value = ________________________

SUBTRACT cost of Environmental Damage fines = ________________________

SUBTOTAL = ________________________

Number of WHITE beads ________ x $100.00 = ________________________

SUBTRACT reclamation cost from SUBTOTAL = ________________________

GRAND TOTAL = ________________________

COAL FLOWERS

PURPOSE: To acquaint your students with a quick way of crystal growing

MATERIALS:

Shallow glass bowls	Salt
Coal Samples	Laundry bluing
Glue	Water
Twigs or Toothpicks	Ammonia
Paper Towels	Food Coloring
String/small pieces of cloth	Paper cups

INSTRUCTIONS:

1. Have students place several small lumps of coal in the glass bowl.

2. Combine twigs, toothpicks, paper and/or cloth with coal. You may select all or just some of the items available. Some items may require glue to hold in place.

3. In separate cup mix: (Do not use paper or foam cups).

6 Tablespoons salt	6 Tablespoons water
6 Tablespoons laundry bluing	1 Tablespoon ammonia

4. After thorough mixing to dissolve all salt, carefully pour the mixture over the coal.

5. Sprinkle dots of food coloring randomly over the mound.

6. Set aside carefully where they can be watched but not disturbed as the crystals are extremely fragile.

Worksheet: Have students follow the growth of their flowers on the worksheet.

Evaluation: What did the crystals form on first? Why? Was there some item in the bowl that crystals did not form on? What effect does the temperature have on the crystal growth and formation?
After a couple of days of growth and students have completed the worksheet have them research the above questions to see if they can find the answers.

Tip: If your local grocery store does not carry bluing check with your local pharmacist, you may also purchase it over the Internet at: www.mrsstewart.com

COAL FLOWER WORKSHEET

Items placed in bowl along with coal:

____________________________ ____________________________
____________________________ ____________________________
____________________________ ____________________________

Colors if any used: ___________ ___________ ___________ ___________

Date and Time Started:____

Date and Time Ended:____

Average Temperature _____________________________________

Where did crystals first appear? _________________________________

Items crystals completely covered? _______________________________________
____

Items no crystals formed on ____

What colors were most vivid? ____

What other items might be used? ____

What effect do you think the temperature of the area the bowl was located in had on the rate of the crystal growth? ____

Why? ____

Check bowl about every two hours to note observations.

COOKIE MINING INSTRUCTIONS

PURPOSE: The purpose of this game is to give the player an introduction to the economics of mining. This is accomplished through the player buying their "property", purchasing the "mining equipment", paying for the "mining operation" and finally paying for the "reclamation". In return the player receives money for the "ore mined". The objective of the game is to make as much money as possible.

INSTRUCTIONS:

1. Each player starts with $19 of play money.

2. Each player receives a Cookie Mining sheet and a sheet of grid paper.

3. Each player must buy his/her own "mining property" which is a cookie. Only one "mining property" per player. Cookies for sale are:
   - Mother's Chocolate Chip - $3.00
   - Chips Ahoy - $5.00
   - Chips Deluxe - $7.00

4. After the cookie is bought, the player places the cookie on the grid paper and, using a pencil, traces the outline of the cookie. The player must then count each square that falls inside the circle. Note: Count partial squares as a full square.

5. Each player must buy his/her own "mining equipment". More than one piece of equipment may be purchased. Equipment may not be shared between players. Mining equipment for sale is:
   - Flat toothpick - $2.00 each
   - Round toothpick - $4.00 each
   - Paper clips - $6.00 each

6. Mining costs are: $1.00 per minute.

7. Sale of a chocolate chip mined from a cookie brings $2.00 (broken chocolate chips can be combined to make 1 whole chip).

8. After the cookie has been "mined", it should be placed back in the circled area on the grid paper, using the mining tools - No fingers or hands allowed.

9. Reclamation costs: $1.00 per square over original count.

COOKIE MINING INSTRUCTIONS (CON'T.)

RULES:

1. No player can use their fingers to hold the cookie. The only thing that can touch the cookie are the mining tools and the paper on which the cookie is sitting.

2. Players should be allowed a maximum of five minutes to mine their chocolate/rainbow chip cookie. Players that finish mining before the five minutes are up should only credit the time spent mining.

3. A player can purchase as many mining tools as the player desires and the tools can be of different types.

4. If the mining tools break, they are not longer useable and a new tool must be purchased.

5. The players that make money by the end of the game win.

6. All players win at the end of the game because they get to eat the remains of their cookie!

REVIEW:

The game provided each player an opportunity to make the most money that a player could make with the resources provided. Decisions were made by each player to determine which properties to buy and which piece or pieces of mining equipment should be purchased.

Each player should have learned a simplified flow of an operating mine. Also, each player should have learned something about the difficulty of reclamation especially in returning the cookie back to the exact size that it was before "mining" started.

NOTE: For lower grade levels, squares can be used to color in for costs in one color and income in another color.

COOKIE MINING SPREADSHEET

1. Name of cookie . . . . ______________________________

2. Price of cookie . . . . ______________________________
(Mothers $3.00, Chips Ahoy $5.00, Chips Deluxe $7.00)

3. Size of cookie . . . . _________ squares covered

4. Equipment:

Flat toothpick _______ x $2.00 = __________

Round toothpick _______ x $4.00 = __________

Paper clip _______ x $6.00 = __________

TOTAL EQUIPMENT COST . . . . ____________________

5. Mining: ________ minutes x $1.00

Cost of removing chips . . . . ____________________

6. TOTAL COST OF MINING . . . . _____________________

7. Chip removal:

Number of chips ________ x $2.00

VALUE OF CHIPS . . . . ____________________

How much did I make?

Value of chips	(±)	_____________
Total cost of mining	(-)	_____________
Reclamation _____ squares x $1.00	(-)	_____________
PROFIT/LOSS	(±)	_____________

CRYSTALS AND CRYSTAL GROWING

INTRODUCTION:

Crystals grow in a variety of ways in nature and a good understanding of crystal growth provides the science student with an understanding of how minerals are formed. More extensive information on crystal formation and mineral identification can be found in the activity Mineral Identification. Crystals are quite common in our daily lives; we use sugar, salt and ice to prepare our foods. High quality crystals such as diamonds and emeralds are used in jewelry. Quartz, mica and other natural crystals are used along with man-made crystals in industry.

We will give you some fairly simple instructions for growing a variety of crystals. Remember that some solutions are hot, others can be harmful if ingested, so have students follow all safety precautions for handling hot solutions and to thoroughly wash their hands after handling the crystal growing ingredients. The alum's required can be located at Laboratory Supply Houses and sometimes a druggist can help locating them.

CRYSTAL GROWTH – SUPERSATURATION

Materials needed:

- 250 ml beaker
- jar
- 10 grams Chrome Alum
- thermometer
- small rock
- 100 ml water
- 18 grams Potash Alum
- hot plate
- paper towels

Procedure:

Add 100 ml of water to the 250-ml beaker. Add 10 grams of Chrome Alum and 18 grams of Potash Alum to the water in the beaker.
Heat water and Alum to 50 degrees C (celsius) on a hot plate, stirring continuously and use the thermometer to find temperature of solution.
Put a clean small rock (approx. 1-inch in diameter) in a small jar and pour the heated solution over it. Place a wet paper towel over the jar and let it cool and remain undisturbed for a couple of days.
Have students assigned to record the changes each day, have other students assigned to draw the formation of the crystals that appear.
Have students do outside research on crystal formation and identification to bring back for classroom discussion.

CRYSTAL GROWTH – EVAPORATION

Materials required:

Petry dish (or similar dish)	Piece of charcoal
Table salt	bluing
Ammonia	food coloring
Containers for mixing solution (glass is preferred)	

Procedure: Mix solution as follows:

100 grams of table salt	180-ml water
180 ml of bluing	30 ml of ammonia

Place charcoal in the Petry dish and slowly pour the solution over the charcoal. Place the dish in a location where it will not be disturbed, add a little ammonia every couple of days to stimulate crystal growth. Drops of different colored food color can be added in various locations to provide colored crystals.

Variety: Add twigs, string, paper, and small rocks to the dish and watch where crystals grow first. Use small pieces of brick instead of the charcoal.

Observations: Have students follow the worksheet for Coal Flowers. Have students compare crystals grown in a warm setting versus a cool one and record differences.

OTHER CRYSTAL GROWING

Halite crystals: Dissolve 1-ounce rock salt in a cup of boiling water. Pour into a shallow bowl then place one end of a string in the solution. Allow to stand, undisturbed for several days in a hot, sunny spot.

Alum crystals: Use same procedure as for halite, substituting powdered alum for rock salt.

Sugar crystals: Use 3 tablespoons sugar per cup of water. Old-fashioned rock candy will grow.

Once these crystals are large enough to clearly see their shapes, remove a few and examine them carefully. A hand lens will help show the shape of the entire crystal and the individual flat sides (faces).

CUPCAKE CORE SAMPLING

Trying to "see" what is beneath the surface of the earth is one of the jobs of a geologist. Rather than digging up vast tracts of land to expose an oil field or to find some coal bearing strata, core samples can be taken and analyzed to determine the likely composition of the earth's interior. In this activity students model core sampling techniques to find out what sort of layers are in a cupcake.

Materials Needed:

Cupcake mix	Plastic knives
Foil baking cups	Food coloring
Drawing paper	Toothpicks
Frosting	Plastic transparent straws

Directions:

Make cupcakes with at least three layers of colored batter. Provide each student with a cupcake, straw, toothpick, and drawing paper. Foil baking cups and frosting will prevent the students from seeing the interior of the cupcakes in much the same way that a geologist can't see the interior of the earth. Ask the students to fold a piece of drawing paper into four sections and in one of the sections draw what they think the inside of the cupcake would look like. Ask the students how they might get more information about the cupcake without peeling the foil or cutting it open with a knife. Someone may suggest using the straw to take a core sample. If not, show them how to push the straw into the cupcake and pull out a sample (straws can be cut to a length slightly longer than the depth of the cupcake.) The students should make a second drawing of the cross section of their cupcake based on the information from three core samples. Each new drawing should be carefully labeled and placed in a different section of the recording paper. Finally, the students should cut open the cupcakes with a knife to compare them to the drawings.

Teacher Hints:

Keep relating what the students are doing to what real life geologists do. Nobody eats until the discussion is complete!

EXTRACTION

PURPOSE:

To introduce students to the concept of extracting valuable minerals from the rock containing the mineral.

MATERIALS REQUIRED:

1-cup iron fortified cold cereal (Total)   2 cups hot water
1 clear drinking glass
White magnet stirring bar or popsicle stick with magnet strip glued to one side then painted with white epoxy paint.

PROCEDURE:

Select a sample of cereal that is iron-fortified such as Total. Add cold, warm or hot water to make a slurry, stirring until the cereal is soggy. The longer the cereal is stirred the more complete the iron removal. Usually 30 minutes gives the maximum iron recovery. After 10 to 20 minutes, remove the magnetic stir bar and note the dark slivers of iron on the ends. These are particles of metallic iron.

EVALUATION:

Why does this work and why is stirring necessary? Cold cereals are fortified with vitamins and minerals for health. Metallic iron is added to fortified cereal and this form of iron is magnetic. In this experiment the magnet collects the iron. In other processing methods for metals, such as copper, uranium, and gold, acidic or caustic water, gravity separation, or flotation might be used. An example of gravity separation is gold-panning. When a gold pan is agitated, the heavier mineral drops to the bottom of the pan and the lighter rocks wash away.

OPTIONS:

What other fortified food product could be used instead of cold cereal? Your students might want to try an iron rich drink or a cooked hot cereal. Have the students crush the cold cereal before adding the water. Does this improve the recovery time? Does it make a difference if the cereal is crushed in a separate container and then transferred to the drinking glass? Students may want to weigh the recovered iron. How did people in earlier times get the iron their body needed? (Remember the old cast iron cookware?)

GEODES

Geodes are discrete bodies of mineral matter with various shapes, but commonly globular or ellipsoidal. They are formed by the inward growth of mineral matter upon the walls of cavities in rocks. Usually geodes are hollow, but may be solid if the process of inward growth of crystals has been carried to completion. This manner of growth distinguishes geodes from nodules or concretions, which grow outward from a nucleus.

They possess relatively solid siliceous or calcareous shells, which are more resistant to weathering than the enclosing rock, so that upon weathering the mineral mass will be freed as a discrete entity, a geode. Not all crystalline openings in rocks can be called geodes. Vugs, for example, are inseparable from the enclosing rock—they have no shell.

Geodes and fossils seldom occur together in the same layer. They can range in size from less than 0.1 inch to over 36 inches, but the average size range is about 2 to 6 inches.

An outstanding feature of the geode is the outer shell, which is usually composed of chalcedony, commonly with an outer film of clay. The shell varies in thickness from a mere film to over an inch, but the thickness of the shell is not related to the size of the geode. The outer surface of the shell is rough and pitted. The shell is usually quite distinct from the layers of crystals on the interior, as well as from the enclosing bedrock because of the difference in composition.

One of the most abundant mineral of geodes is quartz, most common color is the milky white, although some clear crystals are often present. Various shades of the quartz crystals are due to different oxidation stages of an included iron compound. Calcite displays more variations than any other inclusion and is most commonly found as isolated crystals or crystal aggregates on quartz, but in some instances calcite lines the shell.

Some exotic minerals are occasionally found in geodes. Other minerals frequently found include dolomite, ankerite, barite, magnetite, hematite, pyrite, chalcopyrite, sphalerite, limonite, malachite, kaolin and gypsum.

Following are two activities that will allow your students to create a geode in their classroom.

WALNUT SHELL GEODES

The walnut shell geode will simulate the geodes found in nature. These experiments will require some student participation with teacher guidance since students will be heating solutions. Potash Alum can be harmful if ingested; so make sure students wash their hands after handling the geodes. Potash Alum is available at Laboratory Supply Companies. Please insure that all safety precautions are followed

Supplies required:

A hot plate or other heating source
An old saucepan
A large spoon for stirring
Potash Alum (aluminum potassium sulfate can be purchased at chemical supply store)
Water
Walnut shell halves
Empty egg cartons to hold walnut shells filled with crystal growing solution.

Instructions:

Put 100 ml of water into a saucepan then add 36 grams of alum. Gently heat the solution while slowly stirring it with the spoon. If you can not measure the amount of alum, just slowly add it to the water while stirring until no more will dissolve. As soon as the solution is saturated, remove it from the heat source and let it cool. Place the walnut shell halves in the egg cartons and carefully pour or spoon the solution into the shells. Set the egg carton aside where it won't be disturbed for several days. When the water evaporates, students can observe crystals in the walnut shells that simulate geodes.

COCONUT GEODE CLASS DEMONSTRATION

The teacher for lower grade levels should do this demonstration. Higher-grade levels should have teacher guidance during the preparation stage.

Cut a coconut in half and clean the white meat out of it. Seal all cracks with a perma-bond glue of some type that is waterproof. Spray the outside of the coconut shell with lacquer or enamel paint and let dry. Drill or punch a hole into the coconut top usually one of the eyes. Then silicone the two coconut halves back together and let dry. Carefully pour the crystal growing solution into the drill hole. Let the coconut sit for a few days. If the solution has not totally evaporated pour it out. Using a sharp knife or razor blade cut the coconut in half where the silicone seam is. SURPRISE!!